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REORGANIZATION OF AUTOMOTIVE POWER PLANTS RESEARCH

During World War I the investigation of airplane engine performance under service conditions was undertaken by the Heat Division of the Bureau in cooperation with the National Advisory Committee for Aeronautics. Under the direction of H. C. Dickinson, now chief of the Division, the first altitude laboratory in the world was built and equipped in 1917, and much fundamental research was conducted in it during and after the war. The group connected with this work was gradually expanded in conformity with the development of internal combustion engines, eventually forming the automotive power plants section of the Heat and Power Division.

Owing to the increase in volume and growing diversity of the section's activities, it was divided in 1930 into two sections: automotive power plants and fuels and lubrication. Again in 1938 the automotive power plants section was divided into two sections—automotive power plants, and aircraft engines and accessories—under the leadership of H. K. Cummings and M. F. Peters, respectively. The recent resignation of Dr. Peters has made necessary a second reorganization of these important sections, which have expanded greatly since the beginning of the present war. Following as nearly as practicable the duties and interests of the men concerned, Mr. Cummings has been placed in charge of the aircraft engines section, which comprises most of the projects formerly carried on in this section together with some of those from the automotive power plants section. D. B. Brooks has been selected to direct the automotive power plants section, which will continue its work on the large number of projects with which he has been closely identified for several years.

COLOR DESIGNATIONS FOR LIGHTS

Since the development of the ISCC–NBS (Inter-Society Color Council-National Bureau of Standards) system of color names for describing the colors of drugs and medicines (J. Research NBS 23, 355, September 1939, RP 1239), a need has been recognized for a system that would accomplish the same thing for lights. The case was made more urgent by the fact that conflicting names

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are often used in describing the colors of flares, landing lights and beacons, signal lights, and fluorescent and phosphorescent materials.

A tentative extension of the ISCC-NBS system was therefore worked out for lights and is described by Kenneth L. Kelly, research associate of the American Pharmaceutical Association, in the November number of the Journal of Research (RP 1565). High-value hue names, for example red, pink, bluish purple, are used, but not those of low value, such as brown or olive. Color names including modifiers, as for instance pale, weak, or brilliant, are not employed, because the conditions of viewing are so variable that the problem is usually one of separating lights of different hues. The hue names are those used in the ISCC-NBS system and carry the same meaning.

The chromaticity ranges identified by each of these hue names are defined by areas on the ICI chromaticity diagram. The constant-hue boundaries center on the point representing standard illuminant C, and extend out to the spectrum locus. Comparisons are made between the dominant wavelengths corresponding to the centers of the proposed hue-name ranges and similar values reported by a number of authorities. Comparisons are also made with the standard colors recognized in various specifications for marine, railway, aviation, and highway traffic signal glasses.

REACTIONS OF SILCA AND ALUMINA WITH LEAD OXIDE

Lead oxide has been a constitutent of ceramic glazes, glasses, and enamels since the inception of glaze and enamel decoration long before the Christian era. The reason for this is not difficult to deduce. PbO combines with difficulty fusible silica, which is the principal constituent of pottery, to form a glass at temperatures well within the range of the crude furnaces used by the ancients. The glass thus formed is sufficiently viscous to flow smoothly over the surface to be decorated or protected, and the characteristic high index of refraction gives it a pleasing brilliance. Although modern ceramic glasses are much more complex than the early lead silicates, lead oxide is still considered essential to the production of many vitreous enamels, pottery glazes, and artware as well as optical glasses.

About 10 years ago a comprehensive study of phase relations in binary and ternary systems of PbO combined with other oxides used in ceramics was undertaken at the Bureau by R. F. Geller and E. N. Bunting. Several papers have been published, and the latest of these (RP1564 in the November Journal of Research) is a report on the partial systems $PbO\text{-}Al_2O_3$, and $PbO\text{-}Al_2O_3\text{-}SiO_2$.

The compositions investigated are limited practically to those containing over 50 percent of PbO. It is believed reasonably certain that PbO and Al_2O_3 combine to form the compound $PbO.Al_2O_3$ and that a eutectic with PbO exists at about 865° C and 94 percent of PbO. The compound appears to be unstable below the melting point, breaking down to give corundum and liquid.

In the ternary diagram, the greater portion is occupied by the stability fields of corundum and of mullite. The portion investigated disclosed the existence of at least seven compounds. Of these, three are established ($8PbO.Al_2O_3.4SiO_2$, $4PbO.Al_2O_3.2SiO_2$, and $6PbO.Al_2O_3.6SiO_2$), and four are indicated by their optical and X-ray characteristics. The boundaries include 10 established quintuple points, of which 6 are eutectics.

The report also contains a chart showing the indices of refraction of the various compositions as glasses, and gives the determined value of 2,040° C for melting point of Al_2O_3.

CHIPPING AND IMPACT RESISTANCE OF VITRIFIED CHINAWARE

A manufacturer of vitrified chinaware recently requested information concerning the effect, if any, of variations in the hardness of chipping hammers on the apparent resistance of his product to chipping when tested in accordance with Federal Specification M–C–301a. The Bureau had been using the same hammer for years and had never investigated the effect of variations in the hardness of the steel; the Federal specification requiring only that the hammer be made of that material. A study was therefore undertaken using steel hammers of widely varying hardness. Advantage was taken of this opportunity to study also the effect of steel hardness on resistance to impact.

A total of 30 dozen 7-inch hotel-weight rolled-edge plates were subjected to chipping and to impact tests, using six tool-steel chipping hammers and two impact hammers, representing a considerable range in hardness which, expressed in terms of the Vicker's num-

ber, extended from 160 for the untempered steel to 720 for the hardest.

The results show that hammers varying in hardness from 470 to 655 are not damaged in the test and produce chipping values which do not differ significantly. To insure results that can be duplicated in different laboratories, the Federal specification should require a hammer hardened and tempered to a Vicker's number within this range.

Although the impact hammers had hardness numbers of 210 and 665, respectively, the results obtained with them were practically duplicates, and an impact hammer with a hardness in this range would be satisfactory.

Neither variations in water absorption nor in weight affected the chipping or the impact values of these plates, the absorption values for which ranged from 0.00 to 0.19 percent.

The highest percentages of bottom chips were produced on plates having the least slope of the rim and consequently the least height from the base to the edge. Of 12 sections examined, those taken next to bottom chips also showed a materially greater horizontal distance from the point of impact on the edge through the body to the upper surface of the rim.

ABRASION AND SOLUTION OF TEETH

In studying the effect of abrasion and solution on the surfaces of extracted human teeth, Wilmer Souder and Irl C. Schoonover have made use of the diamond hardness indenter described in Technical News Bulletin 267 (July 1939). They were able to detect minute alterations in the tooth surface by noting the changes, after certain treatments, of the calibrated indentation marks.

Abrasive and chemical injuries were disclosed by observing and photographing a series of these marks so arranged that each small area could be definitely identified. Objectionable abrasives in dentifrices were readily detected by brushing a tooth surface on which these marks had been placed. The indentations also gave an indication of the hardness of the tooth, thus making possible the selection of areas of known hardness for experimental tests.

The report on this work, which will be published as RP1563 in the November Journal of Research, contains data showing the initial effects of chemical solutions and bacterial actions that may play important roles in the development of tooth decay.

IRON AS A TANNING AGENT

Our supply of vegetable tanning materials, as well as the chromium used to tan most of the garment and shoe upper leathers for both civilian and military purposes, depends largely upon ships and safe ocean transportation. The importance of developing domestic materials to meet any emergency is illustrated by the fact that only a short time ago the danger of a serious shortage of chromium was such that it was declared a critical material by the War Production Board. Since iron had been shown by previous investigators to offer some promise as a successful tanning agent, and since an abundant domestic supply of this metal exists, an investigation of the use of iron salts for tanning with special attention to the replacement of chromium salts was undertaken by Joseph R. Kanagy and Ruth A. Kronstadt at the Bureau. At the present time the situation with respect to chromium for tanning has been greatly relieved by the utilization of low-grade domestic ores in the manufacture of chromium salts. Nevertheless, the results of the Bureau's work are of interest.

These results, which are reported in RP1566 in the Journal of Research for November, indicate that ferric sulfate may be satisfactorily used if certain organic acids are added to the tanning solutions to stabilize them. Lactic, citric, gluconic, and hydroxyacetic acids were found suitable for stabilizing the iron tanning solutions at the pH required for successful tanning. Without them the iron precipitates as the hydroxide, a form useless for this purpose.

Considerably more iron (Fe_2O_3) than chrome (Cr_2O_3) is required to tan a piece of leather. All hides tanned with the iron contained at least 10 percent of (Fe_2O_3), whereas good leather can be prepared from chromium salts which contain only 5 percent of Cr_2O_3. Experiments with hide powder showed that as much as 25 percent of Fe_2O_3 combined under optimum conditions.

Iron tanning solutions appear to have properties similar to those of chrome tanning solutions. Results of accelerated aging tests on iron tanned goat and calfskins indicated that, on the average, the iron-tanned leather is slightly less resistant to aging than the chrome-tanned leather.

ELECTRICAL CONDUCTANCE OF ROPES

In cooperation with the Corps of Engineers, the electrical conductance of ropes made of fibers other than manila, is being studied. The object is to determine whether the use of these substitute fibers in the neighborhood of live electrical circuits will involve additional hazards to personnel. Thus far, however, each sample under different moisture conditions has been found to have values of resistance differing by factors as great as 1,000,000, whereas under any one moisture condition, the various samples differ by a factor not exceeding 100.

WATER-REPELLENT FABRICS

The development of fabrics that shed water readily and yet permit the wearer to "breathe" through them is especially important to the armed forces. Such fabrics can give protection against all but very heavy rains, and since they only absorb water very slowly, they remain relatively light in weight even under adverse conditions. As a means of testing such water-repellent fabrics, an improved apparatus, referred to as a "drop-penetration apparatus", to simulate the action of rainfall has been devised. Drops of controlled size fall at a constant rate upon the fabric to be tested. The length of time required for water to penetrate through the fabric is taken as a measure of its water-repellency, this time being indicated by means of an electrical signaling device. Water-repellent fabrics have been exposed to severe natural rainfall, as well as the action of the drop-penetration apparatus, and good correlation has been found between the results obtained under the two conditions.

TESTS OF SYNTHETIC RUBBER

The Bureau is cooperating with the Rubber Reserve Company in its efforts for the production of synthetic rubber of uniform, high quality. Careful control, so as to secure uniformity, is necessary, because the 11 synthetic rubber plants now in production are in widely separated localities from Connecticut to California and are necessarily operated by newly-trained and inexperienced personnel. Furthermore, there are differences both in the processes and in the raw materials used. It is the desire of the Rubber Reserve Company, that the rubber from all plants shall be of such uniformity that it can be used interchangeably in the manufacture of rubber goods. To this end the Bureau is assisting in the development of well-defined specifications and in the improvement and clarification of test methods. Samples from each plant are regularly tested at the Bureau, and much cross-checking is done to keep the different laboratories in agreement. Standards which were "good enough" for natural rubber are not adequate for the testing of synthetic rubber.

TREADING AUTOMOBILE AND TRUCK TIRES

The current shortage of rubber, necessitating maximum service from automobile and truck tires, has resulted in an increase in the practice of replacing worn rubber on the treads of used tires by processes known as treading, retreading, and recapping. When properly done, this practice has proved highly satisfactory, and results in greatly increased mileage at a very material saving in the amount of rubber used.

The Bureau has just issued a pamphlet, Commercial Standard CS108–43, that sets forth requirements that the industry considers representative of a high standard for treading automobile and truck tires. The standard covers inspection of the worn tire and the conditions necessary for satisfactory treading; quality of materials used; workmanship; and guarantee to the purchaser.

The establishment of the standard was requested by the National Institute of Treading Standards and the specification was adopted by a general conference held in Washington on September 16, 1942. The conference was attended by representatives of firms engaged in treading, firms that manufacture the equipment and the materials used, transportation organizations, tire rationing boards, and others interested in various phases of the subject. The specification adopted by that conference has been accepted by a large number of those interested, representing a major portion of the productive capacity of the industry.

The pamphlet, entitled "Treading automobile and truck tires," includes such information as the membership of a standing committee for future revisions of the standard, a brief history of the project, and a list of firms, organizations, and individuals that have accepted the specification as their standard of practice. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price is 10 cents.

FEDERAL SPECIFICATIONS FOR PAPERS

One of the important phases of the work of the Bureau's paper section is to obtain technical information on which to base use requirements in the United States Federal Specifications for paper and paper products. These purchase specifications are under the jurisdiction of the Federal Specifications Executive Committee, Procurement Division, Treasury Department, and are formulated by a committee on paper and paper products of which B. W. Scribner, chief of the paper section, is chairman. The development work generally requires considerable testing and even research, always done with the cooperation of the particular branch of the paper industry concerned. The following recent issues of specifications developed in this way are of particular interest.

Paper: stencil, duplicating-machine, dry-process, UU–P–536.—The tissue forming the base of this paper is of particular interest. Formerly all high-grade stencil tissue was made by hand in Japan from materials indigenous to that country. Fortunately, a few years before the war, an American manufacturer using abaca manila hemp developed a machine-made tissue that is equal in all respects to the Japanese product. This was cordage-length hemp, and the war interfered with the supply of this also, to the extent that its use had to be confined as much as possible to the manufacture of rope and other war materials for which substitute fibers could not be used. The American manufacturer of stencil tissue has satisfactorily solved the problem of using substitute fibers for the cordage-length hemp, as evidenced by the severe requirements of the specification based on tests of tissue made from such fibers. For example, in duplicating quality, stencils made from the paper are required to be capable of producing not less than 5,000 legible copies.

Paper: lens, tissue, UU–P–313a.—This revised Federal specification covers a new type of tissue for cleaning lenses and other parts of optical instruments, developed by an American manufacturer in cooperation with the Navy Department and the Bureau.

This tissue supplants the japanese tissue on which the original specification was based, and which is no longer available. The requirements for this paper are severe; it must be very soft, free from abrasive particles, lint, and dusting, and very absorptive. The American tissue is fully equal to the Japanese product in these respects and in addition has a high degree of wet strength accomplished by treatment with a synthetic resin, and superior dry stretch imparted by creping. It was found at the Bureau that when this tissue was fully saturated with water, it retained, on the average, 36 percent of the dry tensile strength in the machine direction and 39 percent in the cross direction of the paper. The stretch of the dry paper in the creped direction averaged over 20 percent. Extensive service trials by the Navy Department also proved the suitability of the paper for the intended uses.

This paper is effecting considerable economy in two ways. It costs $300 per ton as compared with $1,700 for the japanese tissue, and much less of it is required for a given cleaning operation.

Paper: kraft, wrapping, waterproofed, UU–P–271a.—The use of asphalted wrapping paper is essential for heavy-duty packaging of a great many overseas shipments made by our war agencies in order to give them adequate protection against damage by water. The existing Federal specification was based on tests made at the Bureau several years ago. In the meantime many new types of papers had been developed, some of them with particular consideration of wartime requirements. Accordingly, another investigation of the papers was conducted at the Bureau in cooperation with a technical committee of the waterproof-paper group and the container coordinating committee, War Production Board. The result was the development and issuance of an improved specification covering all present standard types of waterproofed kraft wrapping papers.

Papers representative of the various types were tested for weight, water-vapor permeability, water resistance, tensile breaking strength, and stretch, by the methods of the Technical Association of the Pulp and Paper Industry (TAPPI).

The water resistance was determined by both the dry-indicator method and the ground-glass method. The ground-glass method, which was specified in the past Federal specification, was found to be unsuitable for the present types of papers. By this method of test most of the various types were indicated as being practically waterproof, but when tested by the dry-indicator method the time of permeation varied greatly—from as little as 2 hours up to practically no permeation, that is, over 100 hours. Moreover, the latter values were in accord with those to be expected from

the construction of the papers. For these reasons, values obtained by the dry-indicator test are specified in the present revised Federal specification, and TAPPI has withdrawn the ground-glass method. As the investigation also disclosed that the present instructions in the TAPPI dry-indicator method are inadequate for papers that are very resistant to water, the method is to be revised in this respect.

Good correlation was found between the water-vapor permeability and the dry-indicator water-resistance values. This is to be expected for highly impermeable papers, because when water is applied to them, the moisture probably diffuses through them continuously in the form of water vapor. The correlation was so good that specification of water-vapor permeability was considered unnecessary.

The values of stretch of pleated or creped papers varied from 15 to 38 percent. Greatly increased resistance to breakage is secured by these treatments.

The revised Federal specification contains requirements for 37 different papers. The same requirements are contained in the Army-Navy general specification for packaging and packing for overseas shipment. It is believed that papers complying with them will give entirely satisfactory service.

Paper: kraft, wrapping, E–UU–P–268a.—This specification is of interest because a new type, imitation kraft wrapping, has been added to the previous types covering No. 2 and No. 3 kraft wrapping. The latter two types are composed entirely of sulfate fibers and are generally made from virgin material. The imitation kraft is usually made entirely from mixed waste papers with a minimum of 29 percent of sulfate fibers; therefore this type was included for the conservation of virgin sulfate fibers, of which there is an inadequate supply. The requirements for the imitation kraft wrapping were based on tests of the commercial products made at the Bureau, as heretofore there have been no standards of quality for such paper.

REVISED COMMERCIAL STANDARD FOR STRUCTURAL FIBER INSULATING BOARD

Printed copies of the latest Commercial Standard for structural fiber insulating board, CS42–43, in effect since August 25, 1943, are now available. This revision covers five classes of structural fiber insulating board designated as building board, lath for plaster base, roof insulation board, interior board, and sheathing, as compared with two classes in the previous edition issued in 1935.

The standard specifies minimum physical requirements and tests for thermal conductivity, transverse and tensile strength, linear expansion, deflection, and water absorption. It also sets forth requirements for composition, construction, and finish, and lists the standard commercial sizes in which the various classes are made.

Economy and comfort are the two outstanding reasons for insulating a house, and added to these is the wartime necessity for conserving fuel in most areas throughout the United States. This standard should, therefore, be helpful to architects, builders, and home owners.

The booklet includes a brief history of the project, a list of official acceptors, and the membership of the standing committee, whose chief function is to consider revisions of the standard to keep it abreast of the progress of the industry.

Copies of CS42–43 are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price is 5 cents.

PROPOSED SIMPLIFIED PRACTICE RECOMMENDATION FOR HOUSEHOLD INSECTICIDE CONTAINERS

A proposed Simplified Practice Recommendation for containers and packages for household insecticides of the liquid-spray type has been submitted to the producers of insecticides, the glass container manufacturers, and other groups interested for approval or comment.

This recommendation was drafted by a committee of the Household and Industrial Insecticide and Disinfectant Manufacturers in line with plans to increase output and to assist in the program of the War Production Board to assure equitable distribution of containers for essential uses.

It is estimated that the general adoption of this recommendation, that is, the marketing of household insecticides in the standard round pint bottles, instead of the 6-ounce size, should result in a saving of approximately 19 percent of the glass now used. Also it is estimated that the saving in metal for caps, through the use of the pints instead of the 6-ounce bottles, will be approximately 54 percent. There will also be an appreciable saving in soda ash, corrugated shipping cases, and shipping space.

Mimeographed copies of the proposed Simplified Practice Recommendation may be obtained upon request to the Division of Simplified Practice, National Bureau of Standards, Washington 25, D. C.

MATHEMATICAL TABLES

Three more tables in the series prepared by the Mathematical Tables Project, National Bureau of Standards, have been published in the Journal of Mathematics and Physics, and reprints are obtainable at 25¢ each from the Bureau. These are: Table of integrals $\int_0^x J_0(t)\,dt$ and $\int_0^x Y_0(t)\,dt$; Table of $Ji_0(x) = \int_x^\infty \frac{J_0(t)}{t}\,dt$ and related functions; and Table of coefficients in numerical integration formulae. They are designated as MT20, MT21, and MT22, respectively, and these designations should be used in ordering.

NEW AND REVISED PUBLICATIONS ISSUED DURING OCTOBER 1943

Journal of Research [2]

Journal of Research of the National Bureau of Standards, volume 31, number 4, October 1943 (RP1558 to RP1562, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50.

Research Papers [2]

[Reprints from the August and September 1943 Journal of Research]

RP1549. Tristimulus specification of the Munsell book of color from spectrophotometric measurements. Kenneth L. Kelly, Kasson S. Gibson, and Dorothy Nickerson. Price 20 cents.

RP1550. Thermal expansion of some industrial copper alloys. Peter Hidnert and George Dickson. Price 5 cents.

RP1551. Optical rotation and atomic dimension: The four optically active 2-halogenopentanes. Dirk H. Brauns. Price 10 cents.

RP1552. Tensile and other properties of concretes made with various types of cement. Louis Schuman and John Tucker, Jr. Price 10 cents.

RP1555. Calcium chloride compounds of D-α-glucoheptose (D-glycero-D-gulo-aldoheptose). Horace S. Isbell and Harriet L. Frush. Price 5 cents.

RP1556. Density of leather and its significance. Joseph R. Kanagy and Everett L. Wallace. Price 5 cents.

SIMPLIFIED PRACTICE RECOMMENDATIONS [2]

R98–43. Photographic paper. (Supersedes R98–36). Price 5 cents.

R200–43. Paper boxes for toiletries and cosmetics. Price 5 cents.

R201–43. Iron and steel pop safety valves. Price 5 cents.

Commercial Standards [2]

CS14–43. Boys' button-on waists, shirts, junior and sport shirts. (Made from woven fabrics.) 3d ed. (Supersedes CS14–39). Price 5 cents.

CS42–43. Structural fiber insulating board. 3rd ed. (Supersedes CS42–35). Price 5 cents.

CS73–43. Old growth Douglas fir standard stock doors. 2nd ed. (Supersedes CS73–38). Price 10 cents.

CS108–43. Treading automobile and truck tires. Price 10 cents.

Technical News Bulletin [2]

Technical News Bulletin No. 318, October 1943. Price 5 cents. Annual subscription, 50 cents.

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC732. List of commercial standards. (Supersedes LC727).

LC733. List of simplified practice recommendations. (Supersedes LC718).

LC734. Underground corrosion: Publications of the National Bureau of Standards.

RECENT ARTICLES BY MEMBERS OF THE BUREAU'S STAFF PUBLISHED IN OUTSIDE JOURNALS [3]

Standardization of retail package sizes. Ralph W. Smith. Packing and Shipping (Bonnell Publications, Inc., Ma-

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[2] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents a year; Journal of Research, $3.50 a year (to addressees in the United States and its possessions and in countries extending the franking privilege); other countries, 70 cents and $4.50 respectively.

[3] These publications are not obtainable from the Government, unless otherwise stated. Requests should be sent direct to the publishers.

sonic Bldg., Plainfield, N. J.) **70**, No. 5, 5 (Sept. 1943).

An examination of Ofner's method for the determination of invert sugar in refined sugars. Richard F. Jackson and Emma J. McDonald. J. Assn. Official Agricultural Chemists (Box 540, Benjamin Franklin Station, Washington, D. C.) **26**, 462, (August 1943).

Determining the flash points of heavy bodied paints. David Busker. Am. Paint J. (3713 Washington Ave., St. Louis, Mo.) **27**, No. 36, 50 (June 7, 1943).

Values of the constants in the Debye-Hückel equation for activity coefficients. G. G. Manov, R. G. Bates, W. J. Hamer, S. F. Acree. J. Am. Chem. Soc. (1155 16th St., N. W., Washington, D. C.) **65**, 1765 (September 1943).

Further experimental study of beater practice in the manufacture of offset papers. C. G. Weber, M. B. Shaw, and M. J. O'Leary. Paper Trade J. (10 East 39th St., New York, N. Y.) **117**, No. 13, 35 (September 23, 1943).

The density of leather and its significance. Joseph R. Kanagy and Everett L. Wallace. J. Am. Leather Chemists Assn. (Ridgway, Pa.) **38**, 314 (September 1943).

A metallographic study of the formation of ferrite and cementite in an iron-carbon alloy of 0.5 carbon steel. T. G. Digges and S. J. Rosenberg. Trans. Am. Soc. for Metals (7301 Euclid Ave., Cleveland, Ohio) **31**, No. 1, 753 September 1943).

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